SLOVENSKI STANDARD
oSIST prEN ISO 11357-8:2020

01-marec-2020

Polimerni materiali - Diferenčna dinamična kalorimetrija (DSC) - 8. del: Ugotavljanje toplotne prevodnosti (ISO/DIS 11357-8:2019)

Plastics - Differential scanning calorimetry (DSC) - Part 8: Determination of thermal conductivity (ISO/DIS 11357-8:2019)

Kunststoffe - Dynamische Differenz-Thermoanalyse (DSC) - Teil 8: Bestimmung der Wärmeleitfähigkeit (ISO/DIS 11357-8:2019)

Plastiques - Analyse calorimétrique différentielle (DSC) - Partie 8: Détermination de la conductivité thermique (ISO/DIS 11357-8:2019)

Ta slovenski standard je istoveten z: **prEN ISO 11357-8**

ICS:

83.080.01	Polimerni materiali na splošno	Plastics in general

oSIST prEN ISO 11357-8:2020 **en,fr,de**

DRAFT INTERNATIONAL STANDARD

ISO/DIS 11357-8

ISO/TC **61**/SC **5** Secretariat: **DIN**

Voting begins on: **2019-12-31**

Voting terminates on: **2020-03-24**

Plastics — Differential scanning calorimetry —

Part 8: Determination of thermal conductivity

ICS: 83.080.01

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 11357-8:2019(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

A list of all parts in the ISO 11357 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The advantage of using DSC for measuring the thermal conductivity of plastics is that with the same instrument also the specific heat capacity can be obtained. This enables the determination of the thermal diffusivity by dividing the thermal conductivity by the density and specific heat capacity.

In addition, DSC instruments are widely-used and available in almost all test institutes and labs. Hence, measurements of thermal conductivity can be done without need for procurement of an additional instrument.

Plastics — Differential scanning calorimetry —

Part 8: Determination of thermal conductivity

1 Scope

This document establishes a method for determination of the thermal conductivity of solid unfilled and filled or fibre reinforced plastics and composites by means of Differential Scanning Calorimetry (DSC).

It is applicable for materials with thermal conductivities of up to 1 W/(m·K).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 472, *Plastics — Vocabulary*

ISO 6344-1, *Coated abrasives — Grain size analysis — Part 1: Grain size distribution test*

ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and ISO 11357-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

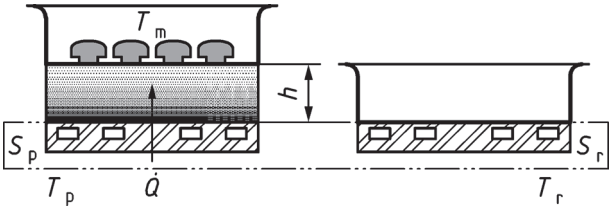
4 Principle

For the determination of thermal conductivity, the usual placement of the specimen in the sample holder position is modified according to a procedure proposed in the literature.[1],[2] Additional details on scientific background, deduction of results and performance of measurements can be found in[3] and [4].

As usual, an empty crucible is placed in the reference position of the sample holder assembly. The test specimen is placed directly onto the sensor of the sample position and a crucible containing a substance of known melting temperature is put on top of the specimen (see Figure 1). The thermal conductivity is measured at a temperature slightly above the melting point of this substance in the small temperature range in which the slope of the melting peak with test specimen is determined (see 9.2, Figure 2)..

Upon heating, a temperature gradient is created in the specimen. The temperature of the top of the specimen remains constant at the melting temperature T_m of the melting substance while the temperature of the bottom side of the specimen corresponds to the temperature of the sample side sensor. The differential heat flow between sample and reference sensor is measured by the DSC instrument.

From the temperature difference between top and bottom of the sample (T_m - T_p), the sample height h and the heat flow rate difference $\dot{Q}$ between sample and the reference sensor, the thermal conductivity of the specimen is determined.



Key

h height of specimen

$\dot{Q}$ heat flow rate difference between sample and reference position

S_p sensor of sample position

S_r sensor of reference position

T_m melting temperature of known substance and temperature of top of specimen, respectively

T_p temperature of sample position and bottom side of specimen, respectively

T_r temperature of reference position

Figure 1 — Schematic layout of measurement

5 Apparatus and substances

5.1 DSC instrument

A DSC instrument in accordance with specifications given in ISO 11357-1 shall be used.

Only original raw data shall be used without any further data processing.

NOTE According to currently available results the method has been verified with heat-flux type DSC instruments only. However, it is expected that power-compensated DSC instruments are suitable, too.

5.2 Crucibles

Aluminium crucibles shall be used fitting the DSC instrument. Both, open or ventilated closed crucibles are suitable. Upon using sealed crucibles suitable precautions shall be taken to prevent excessive inside pressure.

Care shall be taken to avoid deformation of the plane crucible bottom.

NOTE Uneven crucible bottoms may result in too low thermal conductivity values.

5.3 Melting substance

Certified melting substances or melting substances having a purity of 99,9999 % or better shall be used.

The melting temperature determines the temperature of measurement of the thermal conductivity.

Melting temperatures of specimens to be measured shall be above those of the melting substances to be used. In case of doubt, this shall be ensured by performing suitable preliminary tests.

NOTE Metals such as gallium or indium have been found suitable.

5.4 Protective lacquer

If metals that can react with the crucible material are used as melting substances, protective lacquers can be applied for coating the crucible inside surface and preventing formation of alloys with the aluminium crucibles.

NOTE 1 Gallium, for example, is known to form alloys with aluminium.

The protective coating shall be thermally stable in the measurement temperature range and shall be applied continuously on the crucible inside surface in constant thickness of not more than 30 µm.

Both, sample and reference crucible shall be coated in exact the same manner.

NOTE 2 Suitable examples for protective lacquers are e.g. nitro lacquer or permanent marker ink.

5.5 Length measuring device

Suitable device for measuring the diameter with an accuracy of ±20 µm or better and the specimen height with an accuracy of ±10 µm or better.

6 Specimens

6.1 Geometry

Cylindrical specimens shall be used.

The diameter shall be measured with an accuracy of ±20 µm or better and shall not deviate from the diameter of the bottom of the crucible by more than 0,1 mm. The height shall be measured with an accuracy of ±10 µm or better and shall be in the range of 0,5 mm to 2,0 mm.

To ensure the best possible thermal contact to the sensor and crucible, specimens shall be free of scars and burrs and shall have plane-parallel upper and lower surfaces. It is recommended to grind the upper and lower surface using ultra-fine abrasive paper of grit size P800 in accordance with the ISO/FEPA scale specified in ISO 6344-1or better.

NOTE Higher surface roughness may result in reduced thermal contact and lower values of thermal conductivity.

6.2 Number and sampling

At least five specimens shall be measured and the results averaged.

For homogeneous filled and unfilled materials no particular sampling procedures are required.

For fibre reinforced laminates and composites specimens shall be taken at least 10 mm away from sheet edges. Specimens shall be taken from several homogeneously distributed locations of the sheet with exclusion of defective areas.

NOTE Depending on sample preparation and for samples with anisotropic reinforcements the thermal conductivity can depend on the direction of measurement. In such cases the direction of measurement should be noted.

7 Conditioning

Prior to measurement specimens shall be conditioned for a minimum of 2 h in accordance with ISO 291.

Moisture sensitive materials shall be dried preferably in accordance with relevant material standards. Alternatively, drying conditions shall be agreed between involved parties.